RESPONSE TO USEPA AND NJDEP COMMENTS DATED MARCH 9, 2021 ON THE
DRAFT RESPONSE TO AGENCY COMMENTS ON THE DRAFT 2019 GROUNDWATER COMPONENT ANNUAL REPORT
AMERICAN CYANAMID SUPERFUND SITE
BRIDGEWATER TOWNSHIP, NJ

Comment #	Section	Page (pdf)	Paragraph	EPA Comment	WH/Golder Response	EPA Response to "RTC"	WH/Golder Response
3	1.4.4	18	2nd	A summary of the on-going investigations in the South Area, STS and Blue Lot Area should be provided in this section and an explanation should be given on why they have not been included in the annual monitoring report.	The referenced text was revised to address this comment. In addition, see new Section 3.6 which was added in response to similar Comment No. 23.	Partially addressed. A summary on the number of investigations being completed was provided (5 investigations). However a written summary of each investigation was not provided and no reason as to why they were not included have not been included. Provide a summary of each investigation in section 3.6.	A written summary of the activities associated with the South Area and Blue Lot investigations. has been added to the text in Section 3.6. In addition, a summary of the objectives, progress, and status of the five target areas has been included as Table 1, replacing the previous Table 1.
4	1.4.4	18	2nd	This section should provide a discussion of why groundwater sampling in proximity to Middle Brook is under represented. Elevated concentrations of Arsenic in overburden and bedrock groundwater and surface water continue to exceed State and Federal Standards.	A detailed discussion of arsenic in overburden and bedrock groundwater is provided in the previously submitted South Area Investigation Report (South Area, South of STS Data Summary Report; Golder, September 2020), which provided an evaluation of arsenic distribution and attenuation. Further evaluation of arsenic south of the STS property, which is the identified source of arsenic in proximity to Middle Brook, has been further evaluated in accordance with the final South Area Investigation Work Plan (Golder, July 2019). The results of this investigation, including additional evaluation of arsenic distribution and attenuation, will be presented to USEPA in the forthcoming South Area Investigation Data Summary Report. No revisions of the Annual Report were made to address this comment.	Partially Addressed. Make reference to this future report in the text.	Reference to this future report was made in the text.
15	2.1.2.2	26	3rd bullet	This section states "As a result, well plugs were placed in monitoring wells TW-4B and TW- 7A." The paragraph goes on to state that "As a precautionary measure, well plugs were also placed in monitoring wells MW-33S and MW-34S in the DGW PEq compliance monitoring area." Provided more detail on what the purpose the well plugs serve and what the reason for them is.	No revisions have been made to the report text to address this comment. Instead, further clarification in response to the comment is provided below: The well plugs referenced in the text consisted of specially designed well caps or plugs utilized for temporarily sealing artesian wells. These plugs consist of a rubber expansion plug connected to a long shaft. Following the shutdown of PW-2/3, the potential for increases in water levels observed in the listed wells raised concern for the development of artesian or near-artesian conditions with the added influence of the injection wells. Therefore, these plugs were installed as a precaution to prevent groundwater expression above the top of the well casing. The well plugs are easily removed and replaced during the collection of manual water levels from these wells.	Partially addressed. Include the explanation as a note in the report for clarification.	The explanation was added to the 4th bullet in Section 2.1.2.2 in the text.
16	2.1.2.2	26	5th bullet	Explain what is meant by 'significant restrictions on access' for not monitoring the DDDD cluster of wells. These wells have been monitored in the past.	The referenced text was revised to address this comment.	Partially addressed. Difficulties are noted, but could the well have been accessed by foot for continued monitoring? Provide clarification.	While there is physical access to DDDD by foot, work conducted within the NJ ROW requires NJ Transit access approval. Work in the NJ ROW is restricted due to health and safety concerns regarding hazards working in close proximity to the rail line. The referenced text has been clarified
17	2.1.2.3	27	1st	Provide additional justification for the decommissioning of the monitoring wells in the 2019 program.	As stated in the text, the wells decommissioned in December 2019 were proposed in the final Interim GWEIS OM&M Plan (Golder, 2019). The text and Table 15 in that report provides the rationale for the proposed decommissioning of the wells. The reasons for decommissioning can be summarized as follows: - Shallow wells (Addendum 4 S-series wells) not suitable for future monitoring - Damaged wells in locations not needed for future monitoring - Wells screened across multiple hydrogeological units or in impoundments - Wells not needed for future monitoring with maintained monitoring wells located nearby	Partially addressed. Other well decommission activities in this section provided reasons why the wells were decommissioned. For consistency, add the reasons for decommissioning the wells.	The summary of the reasons for decommissioning of the wells in 2019 has been added to the associated section of the report.
21	2.2.5	31	1st	Provide additional details on the strategy to increase/sustain mass removal from the GWEIS.	The referenced text has been revised to address this comment.	Partially addressed. No strategies were included in the report but reference was made to the Draft Routine GWEIS OM&M Plan.	The Draft GWEIS Routine GWEIS OM&M Plan will include strategies on managing the GWEIS with regard to mass removal. The Routine GWEIS OM&M Plan is anticipated to be submitted to USEPA in Q2-2021. The GWEIS in

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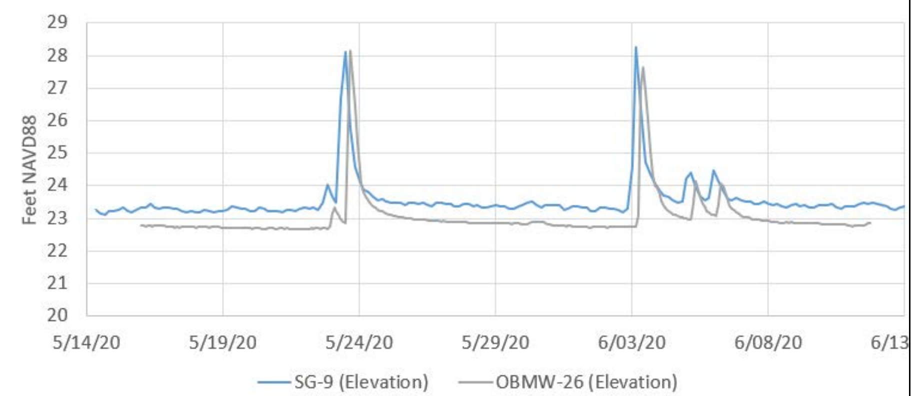
							Q1-Q2-2021 is being operated under the Bio-Tank maintenance operations plan, and mass removal considerations are not included as an objective under these conditions.
32	3.1.1.3	35	3rd	Have the instances where there is an inward gradient across the HBW been cross-checked with precipitation rates and/or water levels in the nearby surface water (Cuckel's Brook / Raritan River) to validate the theory that the surface water is a source of local overburden recharge?	To validate the theory that surface water is a source of local overburden recharge, the continuous water level monitoring that has been implemented in Cuckel's Brook and an adjacent overburden monitoring well outside of the HBW were examined. The data is presented in the graph below. The data show that when Cuckel's Brook (SG-9) rises due to precipitation (two major peaks and three minor peaks observed) a concomitant rise in the overburden groundwater elevation (OBMW-26) is induced following a short lag time.  	Partially addressed. Add the discussion presented in the response to the text.	The discussion has been added to the text
41	3.1.4	38	3rd	This section should provide a discussion on the nature and extent of the NAPL identified in the NAPL monitoring program. The measurable depth of the NAPL which is persistent in the wells should also be presented.	The text was revised to address this comment.	Addressed. It is recommended that a disposable weighted bottom loading bailer be used to confirm the presence/absence and thickness, if present, of the NAPL in the monitoring wells.	Acknowledged
43	3.2.1	38	1st	Describe how the low-flow sampling is completed with Grundfos submersible pumps? Impeller pumps can be problematic for VOC sampling and Grundfos pumps can be difficult to decon.	The text was revised to address this comment. In accordance with the approved Field Sampling and Analysis Plan (FSP, Golder, 2013), low flow sampling is conducted using Grundfos submersible pumps as detailed in Section 8.1 of the FSP. The approved decontamination procedure employed for non-dedicated, submersible pumps utilized for groundwater sampling is discussed in Section 13.1.2 of the FSP.	Partially addressed. The response provided should be added to the text or as a footnote.	The response has been added to the text as a footnote.
45	3.2.3	41	1st	During the reporting period for this annual monitoring report, the CEA had not been approved. The discussion of groundwater trends should focus on exceedances of NJ GWQS and not the 'CEA short list parameters'. Each section should present and discuss any exceedances and trends with respect to NJ GWQS.	Maintaining the focus of the 2019 Annual Report on 'CEA short-list parameters' is appropriate for the following reasons: 1. The groundwater extraction and treatment system is in its early stages of operation when the focus should be on the primary COC. It is anticipated as the groundwater extraction and treatment system has been operated for several years and shows substantive improvement of the CEA short-list parameters, other parameters will be evaluated as well. 2. All parameters with concentrations greater than the GWQS (including non-CEA short-list parameters, which have much less frequent and/or lower concentrations) are highlighted on the groundwater data tables and thus are available to the reviewer if interested. 3. The CEA parameter short-list is an approved list by virtue of the NJDEP approval of the CEA/WRA on September 9, 2020. No revisions to the Annual Report were made to address this comment.	Not addressed. The OU4 ROD identifies the NJ GWQS as performance criteria for the groundwater remedy. Any exceedance of the NJ GWQS need to be discussed in the report.	The text has been revised to include discussion of all exceedances of Site COCs above the NJ GWQS.

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48	3.2.3.1	42	4th bullet	Provide evidence and a discussion of the mechanisms that will attenuate compounds now that they are isolated from the source. For example, what mechanism will attenuate As?	As discussed in Section 5.2.1.5 - Potential Remnant Groundwater Impacts Outside of Hydraulic Control System of the Final GWEIS RDR (Golder, 2019): *"Remnant impacts outside the HBW will dissipate via degradation, flushing, and dilution since the source of these remnant impacts will be cut off immediately via construction of the HBW. Further improvements will be realized via stabilization of Impoundments 3, 4, and 5 and construction of the low permeability cap over the western portion of the North Area. The program for monitoring the attenuation of these groundwater impacts will be included in the OM&M Plan."* As discussed in Section 3.2.3.1 of the Annual Report, the initial groundwater monitoring data collected following HBW installation began to exhibit decreases in groundwater concentrations outside the HBW with certain noted exceptions (see Response to Comment No. 49). It is anticipated that further data in support of the natural decline in remnant groundwater concentrations outside the HBW will be provided once sufficient post-HBW groundwater monitoring well data are collected. The Routine GWEIS OM&M Plan provides a groundwater monitoring plan to track the decline of remnant groundwater concentrations outside of the HBW. Furthermore, the Riparian Zone Flushing Memorandum (O'Brien & Gere, 2011*), explained that remnant groundwater concentrations outside the South Area HBW (installed in 2012) would naturally decline over time due to flushing/dilution from storm events and the associated storm surges. The same principles described in this memorandum are applicable to the other areas of the Site where remnant concentrations of organics and inorganics are currently present outside of HBWs, as storm surges and/or river fluctuations will cause level fluctuations in other surface water bodies as well as in overburden groundwater levels that will facilitate flushing and dilution. No revisions to the Annual Report are proposed to address this comment. * O'Brien & Gere, 2011. Riparian Zone Flushing Memorandum, American Cyanamid Superfund Site, Bridgewater Township, New Jersey, October 21, 2011.	Partially addressed. Include the response presented in the text.	The response has been added to the text.
49	3.2.3.1	44	South Area	Benzene increased from 12.8 to 950 ug/L in PZ-12-13. The argument that this is remnant and attenuation is occurring is not consistent with the data. Provide a discussion on the increase of benzene in this monitoring well.	The change in benzene concentration between the reporting periods is noted. As stated in the text, benzene concentrations in this area are considered to be remnant concentrations of the former overburden plume that originated from Impoundments 1 & 2 which previously discharged to the river via seeps at the riverbank. At the time these seeps were discovered, benzene concentrations were observed to be 20,000 ug/L at the point of discharge in the river. Upon the installation of the HBW and groundwater collection trench, groundwater flow to the seeps was intercepted upgradient of the HBW. The success of this implementation has been confirmed through the collection of semi-annual surface water samples in the Raritan River since construction of the HBW and trench, which demonstrates that the seeps have been mitigated. However, it was acknowledged as part of the South Area groundwater system design that the area of overburden located between the HBW and the river would contain residual concentration that would be allowed to attenuate over time. PZ-12-13 was later installed in the overburden between the HBW and the river in the immediate area of where the seeps were located. Given the concentration of benzene that was present in the overburden plume prior to construction of the HBW, the observed benzene concentrations from PZ-12-13 can be considered representative of remnant impacts. Based on hydrogeologic data collected from overburden upgradient and downgradient of the wall in this area, it has been demonstrated that the HBW is functioning as designed. Therefore, the increase in benzene concentration is not considered to be a result of migration through the HBW.	Partially addressed. Include the response presented to text.	The response has been added to the text.

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					Due to the presence of the HBW, which prevents overburden groundwater flow toward the river, water levels in this well (and other South Area wells outside of the HBW) are subject to seasonal fluctuations and are influenced by river stage and flooding events. During the dry season (fall months), water levels in this well are typically low and often do not support the collection of groundwater samples. While the initial groundwater sample with a benzene concentration of 12.8 ug/L was collected in October of 2014, the subsequent sample with 950 ug/L of benzene was collected in June of 2019 during wetter conditions. It is possible that seasonal water level fluctuations may play a role in the variability of the benzene concentrations observed in this well; however, due to the limited dataset currently available for this well, this hypothesis cannot be supported at this time. As stated in the text, continued monitoring of this well will be conducted in order to better understand the variability of benzene concentrations in this well, the contributing factors to the variability, and the evaluation of attenuation. No revisions to the Annual Report have been made to address this comment.		
51	3.2.3.1	44	West Area	Provide evidence and a discussion of the mechanisms for the '...attenuation of remnant concentrations outside of the HBW'	See Response to Comment No. 48. In addition, Section 5.2.2.6 of the final Revised Final GWEIS RDR (Golder, 2019) discussed remnant groundwater concentrations outside of the West Area HBW as follows: *"Since the source of these impacts will be immediately cut off with the installation of the HBW and operation of the groundwater extraction wells, concentrations in these wells outside the HBW will begin to decline due to continued flushing and dilution from the rise and fall of the Raritan River as well as natural degradation."* The combination of cutting off the source of contamination, together with the flushing and dilution that occurs due to storm events as well as fluctuations in the Raritan River, comprise the primary mechanisms of attenuation in these areas. As with the North Area discussed in Response to Comment No. 48 above, it is anticipated that further data in support of declining remnant concentrations outside the West Area HBW will be provided as sufficient post-HBW groundwater data are collected as per the Routine GWEIS OM&M Plan monitoring. No revision of the 2019 Annual Report was made to address this comment	Partially addressed. Include the response presented to text.	The response has been added to the text.
54	4.1.9	57	VOCs	Section 4.1.9 includes the sediment analytical results for volatile organic compounds (VOCs) and metals. Naphthalene was found at an elevated concentration of 24,000,000 µg/kg at sample location CB-03 in Cuckel's Brook. It is indicated in the document that there is no ecological severe effect level for naphthalene in freshwater sediment so an effects range medium (ER-M) of 2,100 µg/kg for saline environments was used. However, the freshwater sediment values available for naphthalene from NOAA (https://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf) should be reviewed.	Although the comparative criteria (Marine sediment ER-M) t has been used for naphthalene over the past 7+ years of sediment data collection in the absence of a freshwater value, it is acknowledged that the NOAA SQuiRT freshwater sediment Probable Effects Concentration (PEC) of 561 ug/kg can be used as comparative criteria for naphthalene in fresh water. Moving forward (beginning with the 2020 Annual Report), the SQuiRT freshwater sediment PEC will be used as the comparative criteria for naphthalene sediment samples. For the current sediment dataset (2019), the locations with concentrations above the PEC would be the same locations identified using the marine sediment ER-M (i.e., locations CB-03 (July and October 2019) and CB-06 (July 2019)). Therefore, no modification to the current data comparison will be made; however, the SQuiRT freshwater sediment PEC for naphthalene will be utilized for future Annual Reports. No revisions to the Annual Report have been made to address this comment.	Not addressed. Update the reference from ER-M 2,100 ug/kg to PEC 561 ug/kg.	The reference value has been updated in the text.
55	4.1.9	57	metals	Iron was found in sediment at location CB-03 with a concentration of 473,000 mg/kg and has increased from previous years. Although this concentration did not exceed the exposure point concentration, it may be useful to note the occurrence.	Acknowledged. The referenced occurrence has been noted. While WH reviews all of the sediment chemistry trend data, as agreed with USEPA and NJDEP, constituent concentrations are discussed only if they exceed comparative criteria. No revisions to the Annual Report have been made to address this comment.	Not addressed. Note the occurrence of the increasing concentration trends of iron in the report.	The occurrence of the increasing concentration trends of iron has been noted in Section 4.1.10 of the report.

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56	4.1.9	58	metals	It should be noted that the concentration of methyl mercury at CB-04 has increased from the previous years.	Acknowledged. The referenced methyl mercury concentration is less than comparative criteria (see Response to Comment No. 55 above). While an increase in the more recent concentrations is noted, concentrations had previously decreased. No revisions to the Annual Report have been made to address this comment.	Not addressed. Note the occurrence of the increasing concentrations trends of methyl mercury in the report.	The occurrence of the increasing concentration trends of methyl mercury has been noted in the report.
60	5.2.1	68	2nd	Provide additional details on the phenomenon of the increase in potentiometric levels and clarification on the statement '... combined with injections ...'	As described in the paragraph, water levels site wide recovered, or rose, due to the shutdown of PW-3. In addition, the hydraulic pressures developed due to the operation of the injection system causes increases in potentiometric levels that decrease with distance from the injection well area. Depth wise, pressures are somewhat higher in the deeper bedrock groundwater than shallow bedrock groundwater by design as the injection wells were constructed as open primarily within deeper bedrock. The combination of shutdown recovery and injections has had greater influence in the deeper bedrock groundwater wells, particularly wells located along strike relative to the injection wells.	Partially addressed. Include the response presented in the text.	The response has been added to the text.
65	5.2.3	69	3rd	Kriging the groundwater elevation data of bedrock wells should not be relied upon to evaluate hydraulic containment. Hydraulic containment in bedrock should be demonstrated by multiple lines of evidence – water levels, contaminant concentration trends over time and data from extraction wells/trenches over time (i.e., contaminant concentrations in the influent and pumping rates).	Consistent with the GWEIS Final (100%) Remedial Design Report, a multiple line of evidence (MLOE) approach is to be implemented under routine operations to demonstrate hydraulic control of impacted groundwater at the Site. This approach is indicated in Section 5.4.2: "Future OM&M will incorporate a Routine OM&M monitoring plan for groundwater chemistry as a line of evidence that will provide confirmation of hydraulic control analyses or identify areas to adjust operations, and that will develop over time as consistent post-GWEIS trends are obtained." The MLOE approach for hydraulic control of the GWEIS was described in Section 5.3.3 of the GWEIS Final (100%) Remedial Design Report, and several LOE are presented in the OU4 Groundwater Annual Report, e.g., comparison of groundwater flux through a target area to the estimated natural flux, as well as potentiometric contour maps. The discussion of concentration trends in the 2019 OU4 Groundwater Annual Report presented some results relating to the GWEIS, e.g., monitoring wells outside of the HBWs in the overburden. Discussion of chemistry trends in future Groundwater Annual Reports will be further aligned with GWEIS operations and the demonstration of hydraulic control, as the monitoring program beginning in 2H2020 has been revised and aligned with GWEIS objectives. The MLOE approach is consistent with the USEPA guidance for analysis of capture zones of groundwater extraction systems (USEPA, 2008). No revisions to the Annual Report have been made to address this comment.	Partially addressed. Include the response presented in the text.	The response has been added to the text.
67	5.3.1	70	4th bullet	Benzene increased from 12.8 to 950 ug/L in PZ-12-13. The argument that this is remnant and attenuation is occurring is not consistent with the data. Provide a discussion on the increase of benzene in this monitoring well.	See Response to Comment No. 49.	Partially addressed. Include the response presented in the text.	Reference to the detailed discussion included in Section 3.2.3.1 has been added to the text.
78	Appendix B-2	444		Provide a note on why the results for lead and Thallium are highlighted.	The yellow highlighting for Lead and Thallium was included in the DMR for the Second Quarter of 2019 to indicate that the values for Lead and Thallium had been revised. The initial analysis for these elements did not reach target reporting limits. This matter was resolved with the laboratory and results reaching the proper reporting limits were included in revised DMR, which had been submitted to NJDEP by WH.	Partially addressed. Add the note to the sheets or provide the revised DMR.	A note was added to the revised DMR sheet.

References:

USEPA, 2008. A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems, USEPA, Office of Research and Development, January 2008.

RESPONSE TO USEPA AND NJDEP COMMENTS DATED NOVEMBER 16, 2020 ON
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1	1.1.6	14	1st	The sentence states "As a result of past activities at the site, a total of twenty-six lagoon and impoundments….." Confirm the number of historic impoundments and lagoons and make any changes necessary in this section.	The referenced text was revised to address this comment.
2	1.4.1	18	1st	Provide a discussion of the previous groundwater extraction system and how the GWEIS was devised (i.e. discuss the conceptual strategy of why injection/extraction was selected as the most desirable option).	The referenced text was revised to address this comment.
3	1.4.4	18	2nd	A summary of the on-going investigations in the South Area, STS and Blue Lot Area should be provided in this section and an explanation should be given on why they have not been included in the annual monitoring report.	The referenced text was revised to address this comment. In addition, see new Section 3.6 which was added in response to similar Comment No. 23.
4	1.4.4	18	2nd	This section should provide a discussion of why groundwater sampling in proximity to Middle Brook is under represented. Elevated concentrations of Arsenic in overburden and bedrock groundwater and surface water continue to exceed State and Federal Standards.	A detailed discussion of arsenic in overburden and bedrock groundwater is provided in the previously submitted South Area Investigation Report (South Area, South of STS Data Summary Report; Golder, September 2020), which provided an evaluation of arsenic distribution and attenuation. Further evaluation of arsenic south of the STS property, which is the identified source of arsenic in proximity to Middle Brook, has been further evaluated in accordance with the final South Area Investigation Work Plan (Golder, July 2019). The results of this investigation, including additional evaluation of arsenic distribution and attenuation, will be presented to USEPA in the forthcoming South Area Investigation Data Summary Report. No revisions of the Annual Report were made to address this comment.
5	2.1	21	2nd	This section states "Hydrographs illustrating recovery in select bedrock wells in the North Area and West Area, shallow bedrock wells beneath the Impoundment 8 facility, and overburden wells are presented as Figures A-1 to A-4." Figure A-1 through A-4 are not included with the other figures. They are included with Appendix A. Clarify the locations of these figure by adding "....wells are presented <u>in Appendix A</u> as Figures A-1 to A-4"	The respective Appendix reference has been added.
6	2.1.1.1	21	2nd	This section states "Along the eastern perimeter of the North Area, OBE-07 and the North HBW." As shown on Figure 5, OBE-07 is shown on the western side of the North Area. Confirm the correct location of OBE-07 and revise either the maps or report as necessary.	The referenced text was revised to address this comment.
7	2.1.1.1	22	2nd	This section states" Along the western perimeter of the North Area, OBE-13 and the East HBW." As shown on Figure 5 OBE-13 is shown in the south eastern corner of the North Area not the western perimeter. Confirm the correct location of OBE-13 and revise either the map of the text accordingly.	The referenced text was revised to address this comment.
8	2.1.1.1	22	Last	This section states "Table A-1 provides……" Clarify the locations of these tables by adding "Tables A-1, <u>found in Appendix</u> <u>A</u>,...."	The respective Appendix reference has been added.
9	2.1.1.2	22	1st	This section states "The GWEIS extraction and injection flow rates were generally consistent with the design flow rates as presented in the Final GWEIS RDR during the reporting period (June 20 through the end of 2020)." Confirm the year in this sentence and revise as necessary.	The referenced text was revised to address this comment.

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10	2.1.1.2	22	2nd	This section states "Table A-2 presents…." Clarify the locations of these tables by adding "Tables A-2, found in Appendix A,...."	The respective Appendix reference has been added.
11	2.1.1.2	23	3rd	This section states "Figures A-5 to A-7 present…..: Clarify where these figures can be found.	The respective Appendix reference has been added.
12	2.1.2	25	1st	This section states "…. Summarized in Table A-3." Clarify where table A-3 can be found.	The respective Appendix reference has been added.
13	2.1.2.1	25	1st	States "Figure A-9….." Clarify where Figure A-9 can be found.	The respective Appendix reference has been added.
14	2.1.2.2	26	1st bullet	Provide additional details on the SC testing and the limitations of these tests.	Additional information on the SC testing conducted during 2019 is added to Section 2.1.2.2.
15	2.1.2.2	26	3rd bullet	This section states "As a result, well plugs were placed in monitoring wells TW-4B and TW- 7A." The paragraph goes on to state that "As a precautionary measure, well plugs were also placed in monitoring wells MW-33S and MW-34S in the DGW PEq compliance monitoring area." Provided more detail on what the purpose the well plugs serve and what the reason for them is.	No revisions have been made to the report text to address this comment. Instead, further clarification in response to the comment is provided below: The well plugs referenced in the text consisted of specially designed well caps or plugs utilized for temporarily sealing artesian wells. These plugs consist of a rubber expansion plug connected to a long shaft. Following the shutdown of PW-2/3, the potential for increases in water levels observed in the listed wells raised concern for the development of artesian or near-artesian conditions with the added influence of the injection wells. Therefore, these plugs were installed as a precaution to prevent groundwater expression above the top of the well casing. The well plugs are easily removed and replaced during the collection of manual water levels from these wells.
16	2.1.2.2	26	5th bullet	Explain what is meant by 'significant restrictions on access' for not monitoring the DDDD cluster of wells. These wells have been monitored in the past.	The referenced text was revised to address this comment.
17	2.1.2.3	27	1st	Provide additional justification for the decommissioning of the monitoring wells in the 2019 program.	As stated in the text, the wells decommissioned in December 2019 were proposed in the final Interim GWEIS OM&M Plan (Golder, 2019). The text and Table 15 in that report provides the rationale for the proposed decommissioning of the wells. The reasons for decommissioning can be summarized as follows: - Shallow wells (Addendum 4 S-series wells) not suitable for future monitoring - Damaged wells in locations not needed for future monitoring - Wells screened across multiple hydrogeological units or in impoundments - Wells not needed for future monitoring with maintained monitoring wells located nearby
18	2.1.2.3	26	1st	This section states "A-10 shows all wells decommissioned under these programs." Clarify where Figure A-10 can be located.	The respective Appendix reference has been added.
19	2.2.1	27	3rd	This section states "The attached Table B1-1 shows…." Clarify where Table B1-1 is located.	The respective Appendix reference has been added.
20	2.2.1	28	1st- Effluent Monitoring	This section states "Samples were collected on the following dates with results submitted separately to the regulatory agencies (USEPA and NJDEP): March 18th and 26th; April 3rd and 16th; March 15th and 29th; June 19th; July 11th; August 13th; September 3rd; October 16th; November 8th and December 6th." In	The referenced text has been revised to address this comment.

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				the March 15th and 29th dates shown are in addition to the March 18th and 26th dates. Check to see if this is a typo and should say May 15 and 29. Review this sentence and change as necessary.	
21	2.2.5	31	1st	Provide additional details on the strategy to increase/sustain mass removal from the GWEIS.	The referenced text has been revised to address this comment.
22	2.3	31	2nd	The CEA/WRA was established for the Site in September 2020. WH can move forward with the submittal of the ICIAP as well as the CEA/WRA groundwater monitoring plan.	Acknowledged. The referenced text has been updated to address this comment and to clarify that the groundwater monitoring to be included in the Routine GWEIS OM&M Plan will regularly assess the extent of impacts including the CEA/WRA boundary.
23	3.0	32	1st	Include a new section (3.6) that discusses the status of all of the non-routine groundwater monitoring that is being conducted at the site. This should include the location of the programs with respect to the site, the [sic] a summary of the findings and the status of future/on-going groundwater monitoring at these locations.	The referenced text was revised to address this comment.
24	3.0	32	1st	This section states "Section 3.0 presents the results of groundwater monitoring in 2019, which consisted of the following programs during the 1H2020 and 2H2020 monitoring events:" Check dates in this sentence and correct as necessary.	The referenced text was revised to address comment.
25	3.1	33	2nd	This section states "The water level data for all events is presented in Table C-1." Clarify where Table C-1 is located.	The respective Appendix reference has been added.
26	3.1.1.1	33	Footnote 12	Provide details on which wells were corrected for water levels and how the corrections were applied.	The procedure and results for correcting extraction well groundwater elevations for well efficiency, for each well in each sampling event, is attached as Attachment RTC-1. Upon further review of the groundwater contour figures included in Appendix C, a few minor revisions were made to the corrected groundwater elevations values presented on Figures C-2 through C-5. These revisions did not affect the contours or interpretations previously presented and only modified the groundwater elevations at the extraction wells. The revised Figures C-2 through C-5 are included in Appendix C.
27	3.1.1.1	34	1st	This section states" Overburden groundwater elevation contours (Figure C-2) based on the 2019 synoptic event display….." Identify where Figure C-2 can be found.	The respective Appendix reference has been added.
28	3.1.1.2	34	1st	This section states "The flow rates for overburden extraction wells during the synoptic are presented in Table C-2. Overburden groundwater elevation contours for each synoptic event are provided in Figures C-3 to C-5." Identify where Table C-2 and Figures C-3 to C-5 can be found.	The respective Appendix reference has been added.
29	3.1.1.3	35	1st	This section states "The drawdown in these monitoring wells is shown in Figure C-6 which illustrates…." Identify were Figure C-6 can be found.	The respective Appendix reference has been added.
30	3.1.1.3	35	3rd	This section states "Table C-3 provides this comparison……" Identify where Table C-3 can be found.	The respective Appendix reference has been added.

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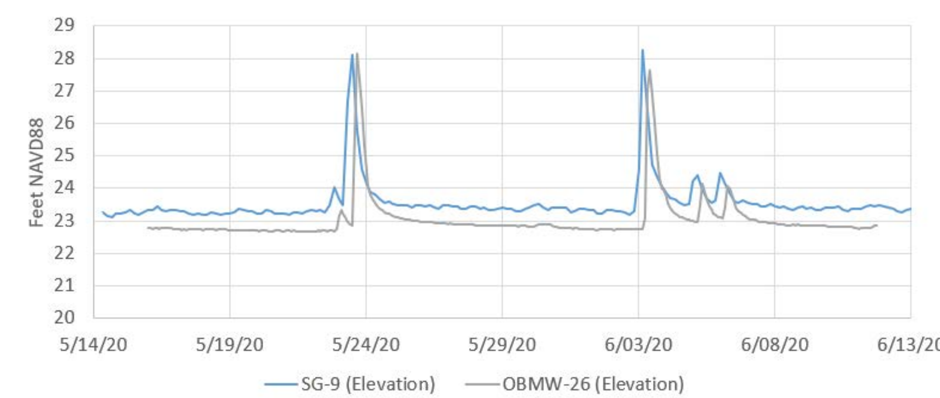
31	3.1.1.3	35	2nd	Where did the design flow rate of 42% of the North Area flow rate come from, and what is the significance of the natural flux rate in this area?	The referenced text in Section 3.1.1.3 has been clarified to address this comment. Specifically, regarding the second part of the comment, one of the potential lines of evidence that can be used to support the effectiveness of an extraction system is to compare the extraction rate from an area to the rate of natural groundwater flow through the same area (natural flux) prior to extraction. If the extraction rate exceeds the natural flux, then that provides a line of evidence for hydraulic control.
32	3.1.1.3	35	3rd	Have the instances where there is an inward gradient across the HBW been cross-checked with precipitation rates and/or water levels in the nearby surface water (Cuckel's Brook / Raritan River) to validate the theory that the surface water is a source of local overburden recharge?	To validate the theory that surface water is a source of local overburden recharge, the continuous water level monitoring that has been implemented in Cuckel's Brook and an adjacent overburden monitoring well outside of the HBW were examined. The data is presented in the graph below. The data show that when Cuckel's Brook (SG-9) rises due to precipitation (two major peaks and three minor peaks observed) a concomitant rise in the overburden groundwater elevation (OBMW-26) is induced following a short lag time. 
33	3.1.2	36	1st	This section states "Two-dimensional groundwater elevation contour maps for shallow and deep bedrock groundwater zones are presented in Appendix C for each of the synoptic events." Reference what Figure number are included.	Text revised to reference appropriate figure numbers.
34	3.1.2	36	1st	This section states "Table C-4 presents a summary……." Identify where Table C-4 can be found.	The respective Appendix reference has been added.
35	3.1.2.2	36	1st	This section states "Table C-2 lists the flow rates for the extraction and injection wells……" Identify where Table C-2 can be found.	The respective Appendix reference has been added.
36	3.1.2.3	37	4th	This section states "Figures C-15 to C-17 present three different images….."Identify where Figures C-15 to C-17 can be found.	The respective Appendix reference has been added.
37	3.1.2.3	37	Footnote 14	A discussion should be provided on why the horizontal anisotropy may underpredict the influence of pumping wells along strike.	The footnote (number 16 in the revised report) has been revised to address the comment.
38	3.1.3	38	1st	This section states "The monitoring of these wells is shown on Figure C-18." Identify where figure C-18 can be located.	The respective Appendix reference has been added.

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39	3.1.4	38	2nd	This section states "These observations are summarized in Table B3-1." Identify where Table B3-1 can be located.	The referenced text was revised to address the comment. In addition, the table reference was revised to Table B4-1 and the name of Appendix B-4 has been clarified.
40	3.1.4	38	2nd	The use of the term 'highly viscous material' is not consistent with the previous paragraph or the title of this section which discusses the presence of NAPL in the wells. NAPL is the appropriate term to be used here, unless chemical analysis can be provided that distinguishes this material.	The phrase “highly viscous material” has been historically used and is appropriate to describe the observed physical characteristics of certain NAPL. However, to address USEPA’s comment, the following phrase “highly viscous NAPL” was used in place of “highly viscous material”. The text was revised to address this comment.
41	3.1.4	38	3rd	This section should provide a discussion on the nature and extent of the NAPL identified in the NAPL monitoring program. The measurable depth of the NAPL which is persistent in the wells should also be presented.	The text was revised to address this comment.
42	3.2.1	38	1st	Define what it means for the bladder pump to be dedicated? Dedicated generally means that pump and associated tubing are used for a single well and no other wells.	The referenced text was revised to address comment.
43	3.2.1	38	1st	Describe how the low-flow sampling is completed with Grundfos submersible pumps? Impeller pumps can be problematic for VOC sampling and Grundfos pumps can be difficult to decon.	The text was revised to address this comment. In accordance with the approved Field Sampling and Analysis Plan (FSP, Golder, 2013), low flow sampling is conducted using Grundfos submersible pumps as detailed in Section 8.1 of the FSP. The approved decontamination procedure employed for non-dedicated, submersible pumps utilized for groundwater sampling is discussed in Section 13.1.2 of the FSP.
44	3.2.1	39	1st	This section states "Table D-1 presents the…….." Identify where Table D-1 can be located. Similarly further down in the same paragraph Table A-1 is referenced. Identify where this table can be located as well.	The respective Appendix references have been added.
45	3.2.3	41	1st	During the reporting period for this annual monitoring report, the CEA had not been approved. The discussion of groundwater trends should focus on exceedances of NJ GWQS and not the 'CEA short list parameters'. Each section should present and discuss any exceedances and trends with respect to NJ GWQS.	Maintaining the focus of the 2019 Annual Report on ‘CEA short-list parameters’ is appropriate for the following reasons: 1. The groundwater extraction and treatment system is in its early stages of operation when the focus should be on the primary COC. It is anticipated as the groundwater extraction and treatment system has been operated for several years and shows substantive improvement of the CEA short-list parameters, other parameters will be evaluated as well. 2. All parameters with concentrations greater than the GWQS (including non-CEA short-list parameters, which have much less frequent and/or lower concentrations) are highlighted on the groundwater data tables and thus are available to the reviewer if interested. 3. The CEA parameter short-list is an approved list by virtue of the NJDEP approval of the CEA/WRA on September 9, 2020. No revisions to the Annual Report were made to address this comment.
46	3.2.3	41	Emerging Contaminants	The emerging contaminants section mentions 1,4 dioxane, but 1,4 dioxane is not included in the Emerging Contaminants report in the Appendix. The exceedance	The intent of providing Appendix G in the Annual Report was to formally present the groundwater PFOA, PFOS, and PFNA analytical results collected in 2019. It was not

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				of 1,4 dioxane above the NJ GWQS should be discussed in each section of the main report.	appropriate to prepare a comprehensive Emerging Contaminants Report in the 2019 Annual Report given that new data, including data from new monitoring wells requested by NJDEP, were to be collected in 2020. As stated in Section 4.0, Appendix G of the Annual Report: *"A comprehensive report describing the groundwater sampling and analyses evaluation of results will be submitted to USEPA and NJDEP following the collection of the Spring 2020 groundwater samples, which includes additional monitoring wells requested by NJDEP and USEPA. This report will provide the information requested by USEPA and NJDEP in their comments on the revised Emerging Contaminants Report and Path Forward Outline initially submitted to USEPA and NJDEP by WH on September 6, 2019 and accepted by USEPA and NJDEP March 26, 2020. In addition to PFOA, PFOS, and PFNA, this report will also discuss and evaluate sampling and analysis results for the other emerging/emerged constituents identified by USEPA and NJDPE, name.ly 1,4-dioxane and 1,2,3-trichloropropane."* The 2019 Annual Report presents all of the 1,4-dioxane groundwater monitoring well data collected in 2019 in the data tables included in Appendices D and F of the 2019 Annual Report. The discussion of the 1,4-dioxane results are provided in the draft Emerging Contaminants Report submitted to USEPA and NJDEP on December 15, 2020 referenced above. In addition, since the detailed discussion of PFOA, PFOS, and PFNA and of 1,4-dioxane are included in the draft Emerging Contaminants Report, providing separate discussion in the 2019 Annual Report was premature and could result in technical conflicts, inconsistencies, and multiple review comments/revisions of both documents. Section 3.5 (which is referenced in Section 3.2.3), has been revised to clarify that 1,4-dioxane will be discussed in the Emerging Contaminants Report.
47	3.2.3	41	1st	This section describes Table D-3 and Figure D-1 but it does not specify where they can be found. Identify where the figure and table can be found	The respective Appendix reference has been added.
48	3.2.3.1	42	4th bullet	Provide evidence and a discussion of the mechanisms that will attenuate compounds now that they are isolated from the source. For example, what mechanism will attenuate As?	As discussed in Section 5.2.1.5 - Potential Remnant Groundwater Impacts Outside of Hydraulic Control System of the Final GWEIS RDR (Golder, 2019): *"Remnant impacts outside the HBW will dissipate via degradation, flushing, and dilution since the source of these remnant impacts will be cut off immediately via construction of the HBW. Further improvements will be realized via stabilization of Impoundments 3, 4, and 5 and construction of the low permeability cap over the western portion of the North Area. The program for monitoring the attenuation of these groundwater impacts will be included in the OM&M Plan."* As discussed in Section 3.2.3.1 of the Annual Report, the initial groundwater monitoring data collected following HBW installation began to exhibit decreases in groundwater concentrations outside the HBW with certain noted exceptions (see Response to Comment No. 49). It is anticipated that further data in support of the natural decline in remnant groundwater concentrations outside the HBW will be provided once sufficient

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					post-HBW groundwater monitoring well data are collected. The Routine GWEIS OM&M Plan provides a groundwater monitoring plan to track the decline of remnant groundwater concentrations outside of the HBW. Furthermore, the Riparian Zone Flushing Memorandum (O'Brien & Gere, 2011*), explained that remnant groundwater concentrations outside the South Area HBW (installed in 2012) would naturally decline over time due to flushing/dilution from storm events and the associated storm surges. The same principles described in this memorandum are applicable to the other areas of the Site where remnant concentrations of organics and inorganics are currently present outside of HBWs, as storm surges and/or river fluctuations will cause level fluctuations in other surface water bodies as well as in overburden groundwater levels that will facilitate flushing and dilution. No revisions to the Annual Report are proposed to address this comment. * O'Brien & Gere, 2011. Riparian Zone Flushing Memorandum, American Cyanamid Superfund Site, Bridgewater Township, New Jersey, October 21, 2011.
49	3.2.3.1	44	South Area	Benzene increased from 12.8 to 950 ug/L in PZ-12-13. The argument that this is remnant and attenuation is occurring is not consistent with the data. Provide a discussion on the increase of benzene in this monitoring well.	The change in benzene concentration between the reporting periods is noted. As stated in the text, benzene concentrations in this area are considered to be remnant concentrations of the former overburden plume that originated from Impoundments 1 & 2 which previously discharged to the river via seeps at the riverbank. At the time these seeps were discovered, benzene concentrations were observed to be 20,000 ug/L at the point of discharge in the river. Upon the installation of the HBW and groundwater collection trench, groundwater flow to the seeps was intercepted upgradient of the HBW. The success of this implementation has been confirmed through the collection of semi-annual surface water samples in the Raritan River since construction of the HBW and trench, which demonstrates that the seeps have been mitigated. However, it was acknowledged as part of the South Area groundwater system design that the area of overburden located between the HBW and the river would contain residual concentration that would be allowed to attenuate over time. PZ-12-13 was later installed in the overburden between the HBW and the river in the immediate area of where the seeps were located. Given the concentration of benzene that was present in the overburden plume prior to construction of the HBW, the observed benzene concentrations from PZ-12-13 can be considered representative of remnant impacts. Based on hydrogeologic data collected from overburden upgradient and downgradient of the wall in this area, it has been demonstrated that the HBW is functioning as designed. Therefore, the increase in benzene concentration is not considered to be a result of migration through the HBW. Due to the presence of the HBW, which prevents overburden groundwater flow toward the river, water levels in this well (and other South Area wells outside of the HBW) are subject to seasonal fluctuations and are influenced by river stage and flooding events. During the dry season (fall months), water levels in this well are typically low and often do not support the collection of groundwater samples. While the initial groundwater sample

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					with a benzene concentration of 12.8 ug/L was collected in October of 2014, the subsequent sample with 950 ug/L of benzene was collected in June of 2019 during wetter conditions. It is possible that seasonal water level fluctuations may play a role in the variability of the benzene concentrations observed in this well; however, due to the limited dataset currently available for this well, this hypothesis cannot be supported at this time. As stated in the text, continued monitoring of this well will be conducted in order to better understand the variability of benzene concentrations in this well, the contributing factors to the variability, and the evaluation of attenuation. No revisions to the Annual Report have been made to address this comment.
50	3.2.3.1	44	South Area	Provide a discussion on the persistence of 1,4 dioxane in the south area including the concentrations in exceedance of NJ GWQS in PZ- 12-12 and PZ-12-26BD.	See Response to Comment No. 46.
51	3.2.3.1	44	West Area	Provide evidence and a discussion of the mechanisms for the '...attenuation of remnant concentrations outside of the HBW'	See Response to Comment No. 48. In addition, Section 5.2.2.6 of the final Revised Final GWEIS RDR (Golder, 2019) discussed remnant groundwater concentrations outside of the West Area HBW as follows: *“Since the source of these impacts will be immediately cut off with the installation of the HBW and operation of the groundwater extraction wells, concentrations in these wells outside the HBW will begin to decline due to continued flushing and dilution from the rise and fall of the Raritan River as well as natural degradation.”* The combination of cutting off the source of contamination, together with the flushing and dilution that occurs due to storm events as well as fluctuations in the Raritan River, comprise the primary mechanisms of attenuation in these areas. As with the North Area discussed in Response to Comment No. 48 above, it is anticipated that further data in support of declining remnant concentrations outside the West Area HBW will be provided as sufficient post-HBW groundwater data are collected as per the Routine GWEIS OM&M Plan monitoring. No revision of the 2019 Annual Report was made to address this comment
52	3.2.3.2	45	North Area	Provide a discussion on the persistence of 1,4 dioxane in the north area including the concentrations in exceedance of NJ GWQS in MW-32D4.	See Response to Comment No. 46.
53	4.1.9	57	2nd	This section states "As stated above, the BERA concluded that were no unacceptable ecological risks and an exceedance of an EPC does not necessarily indicate an unacceptable risk." Review this sentence for structure/wording and change as necessary.	The referenced sentence is redundant with information in the preceding paragraph and has been deleted.
54	4.1.9	57	VOCs	Section 4.1.9 includes the sediment analytical results for volatile organic compounds (VOCs) and metals. Naphthalene was found at an elevated concentration of 24,000,000 µg/kg at sample location CB-03 in Cuckel’s Brook. It is indicated in the document that there is no ecological severe effect level for	Although the comparative criteria (Marine sediment ER-M) t has been used for naphthalene over the past 7+ years of sediment data collection in the absence of a freshwater value, it is acknowledged that the NOAA SQuiRT freshwater sediment Probable Effects Concentration (PEC) of 561 ug/kg can be used as comparative criteria

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				naphthalene in freshwater sediment so an effects range medium (ER-M) of 2,100 µg/kg for saline environments was used. However, the freshwater sediment values available for naphthalene from NOAA (https://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf) should be reviewed.	for naphthalene in fresh water. Moving forward (beginning with the 2020 Annual Report), the SQuiRT freshwater sediment PEC will be used as the comparative criteria for naphthalene sediment samples. For the current sediment dataset (2019), the locations with concentrations above the PEC would be the same locations identified using the marine sediment ER-M (i.e., locations CB-03 (July and October 2019) and CB-06 (July 2019)). Therefore, no modification to the current data comparison will be made; however, the SQuiRT freshwater sediment PEC for naphthalene will be utilized for future Annual Reports. No revisions to the Annual Report have been made to address this comment.
55	4.1.9	57	metals	Iron was found in sediment at location CB-03 with a concentration of 473,000 mg/kg and has increased from previous years. Although this concentration did not exceed the exposure point concentration, it may be useful to note the occurrence.	Acknowledged. The referenced occurrence has been noted. While WH reviews all of the sediment chemistry trend data, as agreed with USEPA and NJDEP, constituent concentrations are discussed only if they exceed comparative criteria. No revisions to the Annual Report have been made to address this comment.
56	4.1.9	58	metals	It should be noted that the concentration of methyl mercury at CB-04 has increased from the previous years.	Acknowledged. The referenced methyl mercury concentration is less than comparative criteria (see Response to Comment No. 55 above). While an increase in the more recent concentrations is noted, concentrations had previously decreased. No revisions to the Annual Report have been made to address this comment.
57	4.1.10	59	2nd	It is indicated that the fines-normalized graph for manganese illustrates a generally decreasing concentration of manganese. However, the manganese bulk sediment graph indicates a increasing trend at location CB-03.	The text for manganese was revised to address this comment. Please note the normalized data are used primarily to assess the spatial variability (e.g., upstream to downstream) versus concentrations at a given location.
58	4.1.10	60	2nd	The temporal and spatial trend graph for Cobalt, provided in Appendix H, show exceedances above the EPC at CB-3. Provide a discussion of the graphs in this section.	A new indented section has been added to the referenced section of the text to address this comment.
59	4.1.10	60	2nd	The temporal and spatial trend graph for Zinc, provided in Appendix H, show exceedances above the EPC and NJDEP SEL at CB-3. Provide a discussion of the graphs in this section.	A new indented section has been added to the referenced section of the text to address this comment.
60	5.2.1	68	2nd	Provide additional details on the phenomenon of the increase in potentiometric levels and clarification on the statement '... combined with injections ...'	As described in the paragraph, water levels site wide recovered, or rose, due to the shutdown of PW-3. In addition, the hydraulic pressures developed due to the operation of the injection system causes increases in potentiometric levels that decrease with distance from the injection well area. Depth wise, pressures are somewhat higher in the deeper bedrock groundwater than shallow bedrock groundwater by design as the injection wells were constructed as open primarily within deeper bedrock. The combination of shutdown recovery and injections has had greater influence in the deeper bedrock groundwater wells, particularly wells located along strike relative to the injection wells.
61	5.2.2	68	2nd bullet	Clarify this statement. It reads as there was draw-down observed in MWs during shutdown of the extraction wells. Was there draw down observed in the MWs once the extraction wells were re-started?	The referenced sentence has been revised to address this comment.

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62	5.2.2	68	3rd bullet	Provide additional information on the average extraction rates vs natural flux.	See Response to USEPA Comment No. 31. One line of evidence that supports the effectiveness of a groundwater extraction system is if the extraction rate from an area exceeds the natural groundwater flux (prior to extraction under natural conditions) from the same area. The text in this section was revised to refer to the discussion of natural flux in section 3.1.1.3.
63	5.2.2	68	4th bullet	The sentence reading "...outward gradients were also observed at some locations..." seems to contradict the following sentence: "Demonstration of continuous spatial hydraulic influence…' Provide clarification.	The bullet has been removed from the text. The intent of the bullet was to re-emphasize that continuous drawdown was developed inside of the HBWs along the series of extraction wells in the West and North Areas, and despite a small number of localized areas of outward gradients as discussed in section 3.1.1.3 during some monitoring events, the demonstration of drawdown inside the HBWs support the attainment of hydraulic control.
64	5.2.2	69	2nd	Remove the words ..'if deemed necessary…' . As identified in the approval of the HBW RAR, the gaps in the HBW are to be closed during the ICSWS remedial action.	The text has been revised consistent with the language in the final RAR-HBW (page 17; Golder, September 2019), which states: *"The utilities associated with the gaps in the HBW must remain active for the foreseeable future and WH will address the gaps as part of the ICSWS remedial design after GWEIS performance data have been collected and evaluated."*
65	5.2.3	69	3rd	Kriging the groundwater elevation data of bedrock wells should not be relied upon to evaluate hydraulic containment. Hydraulic containment in bedrock should be demonstrated by multiple lines of evidence – water levels, contaminant concentration trends over time and data from extraction wells/trenches over time (i.e., contaminant concentrations in the influent and pumping rates).	Consistent with the GWEIS Final (100%) Remedial Design Report, a multiple line of evidence (MLOE) approach is to be implemented under routine operations to demonstrate hydraulic control of impacted groundwater at the Site. This approach is indicated in Section 5.4.2: "Future OM&M will incorporate a Routine OM&M monitoring plan for groundwater chemistry as a line of evidence that will provide confirmation of hydraulic control analyses or identify areas to adjust operations, and that will develop over time as consistent post-GWEIS trends are obtained." The MLOE approach for hydraulic control of the GWEIS was described in Section 5.3.3 of the GWEIS Final (100%) Remedial Design Report, and several LOE are presented in the OU4 Groundwater Annual Report, e.g., comparison of groundwater flux through a target area to the estimated natural flux, as well as potentiometric contour maps. The discussion of concentration trends in the 2019 OU4 Groundwater Annual Report presented some results relating to the GWEIS, e.g., monitoring wells outside of the HBWs in the overburden. Discussion of chemistry trends in future Groundwater Annual Reports will be further aligned with GWEIS operations and the demonstration of hydraulic control, as the monitoring program beginning in 2H2020 has been revised and aligned with GWEIS objectives. The MLOE approach is consistent with the USEPA guidance for analysis of capture zones of groundwater extraction systems (USEPA, 2008). No revisions to the Annual Report have been made to address this comment.
66	5.3.1	70	1st	This section should recognize the historic elevated concentrations of Arsenic in overburden and bedrock groundwater that are not being controlled by the GWEIS or HBW.	The referenced section (for overburden) and Section 5.3.2.4 (for bedrock) have been revised to address this comment.

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67	5.3.1	70	4th bullet	Benzene increased from 12.8 to 950 ug/L in PZ-12-13. The argument that this is remnant and attenuation is occurring is not consistent with the data. Provide a discussion on the increase of benzene in this monitoring well.	See Response to Comment No. 49.
68	5.3.2.1	71	Footnote 23	Provided a reference to the 'Blue Lot Investigation' to document the statements in this footnote.	The referenced footnote has been revised to address this comment.
69	5.3.2.1	70	1st	Reword the statement in brackets to say 'except for arsenic where the primary source is considered to be on the STS property'	The referenced text has been revised to address comment.
70	5.3.2.4	71	1st	The last sentence implies that the higher As concentrations in SS-D are related to the artesian conditions in the well. The historical concentrations of arsenic in this well have not changed considerably and there does not seem to be a strong correlation with the artesian conditions. Provide additional discussion to demonstrate this concept or reword the sentence.	The referenced text has been revised to address comment.
71	5.3.2.4	71	1st	The title of this section should be renamed - 'South Area - Shallow Bedrock'. There were no bedrock monitoring wells in the South Area during the 2019 reporting period and this should be noted in the first paragraph and the title renamed.	The title of this section is accurate as both shallow and deep (JJJJ-D and SS-D) monitoring well results are discussed in this section. No revisions of the Annual Report were made to address this comment.
72	6.1	73	1st	This section identifies the need to address emerging contaminants, but the results of the GWTF influent/effluent for PFAS and 1,4 dioxane are not found in the report. They should be provided in Appendix G.	See Response to Comment No. 46.
73	References	76		The Draft VI evaluation report is now final.	Acknowledged. Text has been revised to reflect the final submittal and a reference to the final report has been added to the reference list.
74	Figure 5	82		Well Set JJJJ-D and JJJJ-S are not depicted on Figure 5, JJJJ-O is shown. Review the figure and Section 3.2.3.2 South Area (PDF page 46) and revise as necessary for consistency.	Well set JJJJ is not depicted on Figure 5, but Figure 3 has been revised to include JJJJ-D and JJJJ-S.
75	Appendix A-1	110	Backwash Procedure - BRI-07	This section states "Four (4) samples were collected from depths of 80, 120, and 340 ft bgs." Please clarify? Were 4 samples collected from 3 intervals? Or were 4 samples collected from 4 intervals?	Two samples were collected from the 80 ft bgs depth, as specified in the second sentence in this paragraph. One sample was collected from each of the 120 and 340 ft bgs depths, for a total of four samples collected from three intervals.
76	Appendix B-1	375	Table B1-1	The title of this section is operational performance and effluent data, but no effluent data is presented in Table B1-1.	The 2019 Effluent Discharge Permit Self-Monitoring Report forms have been added to Appendix B-1.
77	Appendix B-2	446		Check title of this section, it is titled quarterly Discharge monitoring reports, but the following reports are for residuals transfer.	The title for this section is correct. The Quarterly Discharge Monitoring Reports have been correctly added to the Appendix.
78	Appendix B-2	444		Provide a note on why the results for lead and Thallium are highlighted.	The yellow highlighting for Lead and Thallium was included in the DMR for the Second Quarter of 2019 to indicate that the values for Lead and Thallium had been revised. The initial analysis for these elements did not reach target reporting limits. This matter was resolved with the laboratory and results reaching the proper reporting limits were included in revised DMR, which had been submitted to NJDEP by WH.

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79	Appendix D-3	659		Provide Figure numbers for all groundwater charts and ensure that notes on the charts are readable.	Chart numbers have been added and notes are readable.
80	Appendix D-3	662		For charts where there is a large range in concentration data (i.e. 38R, AAA, CCC-R), VOCs should be presented on separate charts as was done in previous groundwater monitoring reports.	Charts with large range in concentration data have been presented as separate charts.
81	Appendix D-3	666		Adjust the chart since the Y-axis drops below zero.	The Y-axis has been fixed.
82	Appendix D-3	676		Adjust the chart since the Y-axis drops below zero.	The Y-axis has been fixed.
83	Appendix D-3	679		Adjust the chart since the Y-axis drops below zero.	The Y-axis has been fixed.
84	Appendix D-3	716		For charts where there is a large range in concentration data (i.e. 38R, AAA, TFP-94-1R), SVOCs should be presented on separate charts as was done in previous groundwater monitoring reports.	See response to Comment No.80.
85	Appendix F - 2.5.1	804	2nd	This section states "The detection of hexachlorobenzene in RCRA-D9 of 0.057 ug/L in 1H2019 was marginally above the GWQS of 0.20ug/L and is likely a remnant of pre-RCRA operations in the area." Review this statement and change as necessary.	This statement was updated to note that the GWQS for hexachlorobenzene is 0.02 ug/L
86	Appendix E - 3.0	750	1st	This section states "Collection of groundwater samples was performed in accordance with the FSAP (Golder, 2014) and followed the NJDEP Field Sampling Procedures Manual (NJDEP, 2005)." Define FSAP.	The FSAP was defined in the List of Acronyms and has now been defined in this Appendix. In addition, two previous references to FSP (one in main text Section 3.2.1 and one in Appendix E, Section 9.0) have been changed to FSAP.
87	Appendix E - 5.0	752	1st	Makes mention of Tables C-1, Figure C-7, C-8, C-10 and C-13. However it does not make mention where they can be found. Identify where the reference information can be found.	The respective Appendix reference has been added.
88	Appendix E - 6.0	753	1st	Provide GWTF effluent samples in the Appendix.	GWTF effluent results are included in Appendix B-1. The text in Section 6.0 has been revised to include a reference to Appendix B-1.
89	Appendix E - 7.2	754	3rd	This section states "The SVOC 2,6-dinitrotoluene was the only VOC detected in 2019." It talks about the same compound as both SVOC and VOC in the same sentence. Check this sentence and change as necessary.	The text has been updated to address this comment.
90	Appendix G	934		Include the results for PFAS and 1,4 dioxane from the GWTF influent/effluent	The text has been revised presenting new Table G-4, which contains the GWTF influent/effluent results.
91	Appendix G	934	Table G-3	Update PFAS groundwater criteria to the table.	Table G-3 presents PFAS results for leachate samples as opposed to groundwater samples. Therefore, the PFAS groundwater criteria were not included on this table. No revisions to the table were made to address this comment.
92	Appendix G	933	Table G-2	Update PFAS groundwater criteria to the table.	Table has been updated with the new PFAS criteria to address this comment.
93	Appendix H	985		Provide surface water charts for all COCs for Cuckhold's Brook. Only manganese and benzene have been presented.	As done in previous submittals, only compounds of concern that exceed the applicable standards in the select time frame (i.e., 2019) are presented in the trend charts.

Comment #	Section	Page (pdf)	Paragraph	Comment	Response
94	Appendix H	995		Provide Figure numbers for all Sediment charts. Also ensure that criteria lines extend the entire length of the x-axis	Chart numbers have been added and X-axis has been updated.
95	Appendix H	994	Pond 287	The vertical orange line for benzene does not make sense and is not in the legend. Also provide a Figure number.	The vertical line was to indicate a large difference in the benzene concentration. Two charts have been provided to show two different Y-axis concentrations at a small and larger scale.
96	Appendix H	985		Provide Figure numbers for all Surface Water charts.	Chart numbers have been added.
97	Appendix I	1119		Add historic graphs (all ambient air monitoring results) for benzene and napthalene for the 12 air monitoring stations	As the objective of the site-wide AA monitoring program is to develop a baseline set of ambient air monitoring data prior to remedy implementation, WH believes that data tables are more appropriate for presenting historic data. Tables of these data can be provided upon agency request. No revisions to the Annual Report have been made to address this comment.

References:

USEPA, 2008. A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems, USEPA, Office of Research and Development, January 2008.

1.0 INTRODUCTION

The Hantush-Bierschenk method for determining well efficiency (Hantush, 1964[1] and Bierschenk, 1963[2]) was used to analyze the results of step-drawdown tests conducted during the 2016 Pre-Design Investigation (PDI) and subsequent step tests conducted in December 2019 and January 2020 to estimate the linear and non-linear well loss coefficients**,** B and C. The B and C coefficients were then used to estimate drawdown (s_w) and well efficiency (E_w) for each overburden extraction well. The general equation (Rorabaugh, 1953)[3] for calculating drawdown inside a pumping well, including well losses is:

$$s_w = BQ + CQ^p$$

where,

s_w = drawdown inside the well

B = linear well-loss coefficient

C = non-linear well-loss coefficient

Q = pumping rate

p = non-linear well loss fitting coefficient. A value of 2 is typically used for p (Kruseman and de Ridder, 1990[4]).

The general equation for calculating well efficiency (Kruseman and de Ridder, 1990) is:

$$E_w = \left\{\frac{BQ}{BQ + CQ^p}\right\} \times 100\%$$

where,

E_w = well efficiency

B = linear well-loss coefficient

C = non-linear well-loss coefficient

Q = pumping rate

p = non-linear well loss fitting coefficient

For the determination of parameters B and C, a plot of the incremental drawdown (the difference in drawdown between each step of a step test) divided by flow rate ($S_{w(n)}/Q$) vs flow rate (Q) yields a straight line with a y-intercept equal to B and a slope equal to C (example from Kruseman and de Ridder, 1990).

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[1] Hantush, M.S., 1964. Hydraulics of wells. In: V.T. Chow (editor). Advances in hydroscience, Vol. 1, pp. 281-432. Academic Press, New York and London.

[2] Bierschenk, W.H., 1963. Determining well efficiency by multiple step-drawdown tests. Intern. Assoc. Sci. Hydrol. Publ. 64, pp. 493-507.

[3] Rorabaugh, M.J., 1953. Graphical and theoretical analysis of step-drawdown test of artesian well. Proc. Amer. Soc. Civil Engrs., Vol. 79, separate no. 362, 23 pp.

[4] Kruseman, G.P. and N.A. de Ridder, 1990. Analysis and Evaluation of Pumping Test Data, Second Edition (Completely Revised): ILRI publication 47. Intern. Inst. for Land Reclamation and Improvements, Wageningen, Netherlands, 377 p.[http://www.hydrology.nl/images/docs/dutch/key/Kruseman_and_De_Ridder_2000.pdf]

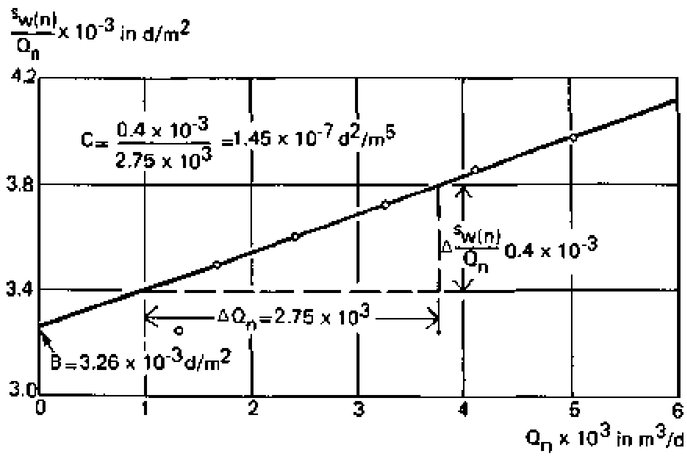
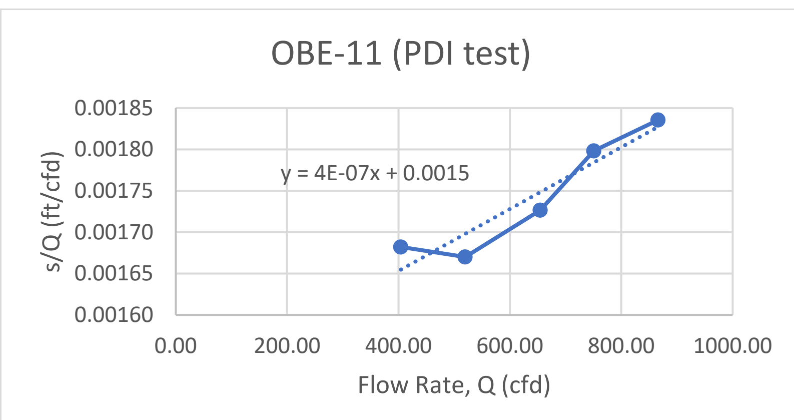


Figure 14.3 The Hantush-Bierschenk method: determination of the parameters B and C

Multiple step-drawdown tests were conducted on each OBE well to estimate B and C and well efficiency over time. The resulting well efficiencies and water level correction factor for each well for each event are summarized in Table RTC-1. Well efficiency was estimated as 50% for wells that did not achieve target flow rates and exhibited Hantush-Bierschenk plots that did not result in a straight-line fit. Some wells achieved design flow rates during step testing but exhibited slightly increasing specific capacity with increasing flow rate, and were estimated with 100% efficiency.

An example calculation based on data collected from OBE-11 during the PDI is included below[5]. Step testing conducted on OBE-11 in July 2016 included five steps at flow rates ranging from 2.1 to 4.5 gpm. A Hantush-Bierschenk plot of $S_{w(n)}$/Q vs Q was created to estimate the B and C well loss coefficients.

Figure RTC-1 – Hantush-Bierschenk Plot for OBE-11



As depicted in Figure RTC-1, the y-intercept (B) is estimated as 1.5E-03 ft/cfd. The slope of the line (C) is estimated as 3.73E-07. The B and C coefficients were then substituted into the general well efficiency equation to yield estimated well efficiencies for each flow rate ranging from 83 to 91% (Table RTC-2). As the actual well flow rate (8.6 gpm) during the July 2019 synoptic was greater than the range of testing (maximum of 4.5 gpm), a well efficiency of 0.50 was conservatively estimated in this instance. In another example, OBE-05 in July 2019 was pumping at a rate of 2.4 gpm, which corresponded to a well efficiency of 58% based on the PDI step testing as shown in Table RTC-2. Tables RTC-2 and RTC-3 summarize the results of the PDI testing, and the December

[5] For the graphical analysis, consistent units of feet and cubic feet per day (cfd) are utilized.

2019 and January 2020 testing[6]. The PDI test results were applied to the April, June and September 2019 water levels, and the December 2019/January 2020 testing was applied to the December 2019 water levels. As noted above, some test results yielded values of 100% efficiency, and as well testing is planned to be conducted regularly as specified in the Routine GWEIS OM&M Plan, these values may be revised accordingly.

[6] Additional testing in February 2020 was not incorporated into these results but will be incorporated into future calculations.

Table RTC-1 - Estimated Overburden Extraction Well Efficiencies

Well ID	April 2019 Estimated Well Efficiency (Percent)	April 2019 Correction Factor (ft)	July 2019 Estimated Well Efficiency (Percent)	July 2019 Correction Factor (ft)	September 2019 Estimated Well Efficiency (Percent)	September 2019 Correction Factor (ft)	December 2019 Estimated Well Efficiency (Percent)	December 2019 Correction Factor (ft)
OBE-01	50%	5.56	50%	6.29	50%	6.00	100%	0.00
OBE-02	32%	7.74	32%	9.49	32%	8.84	100%	0.00
OBE-03	50%	0.59	50%	4.85	50%	4.25	100%	0.00
OBE-04	50%	5.29	50%	5.94	50%	4.92	100%	0.00
OBE-05	58%	3.44	58%	4.47	70%	3.20	63%	3.55
OBE-06	50%	4.68	50%	2.84	50%	2.66	100%	0.00
OBE-07	50%	5.63	50%	5.44	50%	3.01	100%	0.00
OBE-08	50%	5.89	50%	6.36	50%	4.94	100%	0.00
OBE-09	70%	2.99	70%	2.02	80%	0.64	70%	2.42
OBE-10	70%	4.04	70%	3.96	70%	2.58	100%	0.00
OBE-11	-	-	50%	5.77	50%	4.50	83%	0.50
OBE-12	-	-	50%	3.35	50%	2.51	100%	0.00
OBE-13	50%	2.64	50%	2.69	100%	0.00	100%	0.00
OBE-14	-	-	-	-	50%	4.94	50%	0.50
OBE-15	-	-	50%	4.69	50%	1.03	50%	0.69
OBE-16	63%	2.52	63%	3.27	63%	2.66	68%	3.16

Notes:

1) April and July 2019 well efficiency based on PDI field step tests (PDI Summary Reports and Addendum 7/Addendum 7 Supplement Reports) and summarized in Table 8 of Interim GWEIS Operation, Monitoring, and Maintenance Plan (Golder, August 2018).
2) Blue highlighted cells indicate estimated well efficiency of 50% based on proximity and similarity to nearby tested wells, or is a conservative estimate
3) Gray highlighted cell indicates well was not actively pumping.
4) Correction factor is difference between uncorrected and corrected groundwater elevations
5) September 2019 well efficiencies for OBE-05, OBE-06, OBE-09 and OBE-13 were modified from PDI well efficiency values based on less than anticipated drawdown in the well. Pending follow-up testing.
6) December 2019 well efficiencies based on step tests conducted on December 21, 2019, and January 1, 4, 10-11, 18, 2020

Abbreviations:

ft = feet

Chkd by: RL 1-8-21
Revd by: WG 1-8-21

Table RTC-2 - Well Efficiencies for April, July and September 2019 Synoptic Events and PDI Test Summaries

Well ID	Date	Analysis	2016 PDI Step Testing: Step Flow	2016 PDI Step Testing: Drawdown	2016 PDI Step Testing: Specific Capacity	2016 PDI Step Testing: Estimated Well Efficiency**	Estimated Average Well Efficiency	April 2019 Flow	April 2019 Estimated Well Efficiency	July 2019 Flow	July 2019 Estimated Well Efficiency	September 2019 Flow	September 2019 Estimated Well Efficiency
			[gpm]	[feet]	[gpm/ft]	%	%	[gpm]	%	[gpm]	%	[gpm]	%
OBE-01	N/A	Step Drawdown Test	-	-	-	-	N/A	3	50	3.8	50	4	50
			-	-	-	-							
			-	-	-	-							
OBE-02	7/27/2016	Step Drawdown Test	1.40	1.55	0.9	57	41	4.4	32	5	32	4.6	32
			2.60	3.38	0.8	42							
			3.60	5.99	0.6	34							
			4.00	7.87	0.5	32							
OBE-03	N/A	Step Drawdown Test	-	-	-	-	N/A	2.5	50	3.5	50	3	50
			-	-	-	-							
			-	-	-	-							
OBE-04	N/A	Step Drawdown Test	-	-	-	-	N/A	4	50	5.3	50	4.3	50
			-	-	-	-							
			-	-	-	-							
OBE-05	7/20/2016	Step Drawdown Test	1.30	1.21	1.1	72	57	2	58	2.4	58	1.7	70
			2.00	1.93	1.0	63							
			2.80	2.56	1.1	55							
			3.70	3.88	1.0	48							
			4.20	4.71	0.9	45							
OBE-06	N/A	Step Drawdown Test	-	-	-	-	N/A	7	50	5.2	50	4.7	50
			-	-	-	-							
			-	-	-	-							
OBE-07	N/A	Step Drawdown Test	-	-	-	-	N/A	5.3	50	5.6	50	6	50
			-	-	-	-							
			-	-	-	-							
OBE-08	N/A	Step Drawdown Test	-	-	-	-	N/A	4.4	50	3.8	50	3.2	50
			-	-	-	-							
			-	-	-	-							
OBE-09	7/6/2016	Step Drawdown Test	2.00	1.21	1.7	87	84	13.2	70	12	70	3	80
			2.70	1.72	1.6	84							
			3.40	2.24	1.5	80							
OBE-10	N/A	Step Drawdown Test	-	-	-	-	N/A	6.3	70	7.4	70	6.8	70
			-	-	-	-							
			-	-	-	-							
OBE-11	7/6/2016	Step Drawdown Test	2.10	0.68	3.1	91	87	0	N/A	8.6	50	5	50
			2.70	0.87	3.1	89							
			3.40	1.13	3.0	87							
			3.90	1.35	2.9	85							
			4.50	1.59	2.8	83							
OBE-12	N/A	Step Drawdown Test	-	-	-	-	N/A	0	N/A	7.4	50	4.1	50
			-	-	-	-							
			-	-	-	-							
OBE-13	N/A	Step Drawdown Test	-	-	-	-	N/A	14.7	50	17.14	50	9.1	100
			-	-	-	-							
			-	-	-	-							
OBE-14	6/29/2016	Step Drawdown Test	2.00	7.49	0.27	19	15	0	N/A	0	N/A	2	50
			2.40	11.11	0.22	11							
OBE-15	10/5/2016	Step Drawdown Test	1.00	1.37	0.7	N/A	N/A	0	N/A	4	50	0.8	50
			2.00	1.58	1.3	N/A							
			2.50	5.05	0.5	N/A							
OBE-16	10/4/2016	Step Drawdown Test	1.90	0.41	4.6	79	70	6.3	63	6.76	63	1.6	63
			2.50	0.64	3.9	74							
			3.40	0.87	3.7	68							
			3.80	1.02	3.7	68							
			4.20	0.99	4.2	63							

Notes:

** - Hantush-Bierschenk method used to estimate well efficiency

N/A - Not Applicable

Table RTC-3 - Well Efficiencies for December 2019 Synoptic Event and December 2019/January 2020 Test Summaries

Well ID	Date	Analysis	December 2019/January 2020 Step Testing						
			Total Flow Rate	Total Drawdown	Specific Capacity	Estimated Well Efficiency**	Estimated Average Well Efficiency	December 2019 Flow Rate	December 2019 Est. Well Efficiency
			[gpm]	[feet]	[gpm/ft]	%	%	[gpm]	%
OBE-01	1/10/2020	Step Drawdown Test	4.0	11.7	0.34	128	100	4.5	100
			2.7	7.8	0.35	119			
			1.3	4.5	0.29	108			
OBE-02	1/11/2020	Step Drawdown Test	5.4	12.3	0.44	111	100	6.1	100
			3.6	7.9	0.46	108			
			1.8	4.4	0.41	103			
OBE-03	1/11/2020	Step Drawdown Test	3.4	10.0	0.34	121	100	3.7	100
			2.2	6.6	0.33	113			
			1.1	3.7	0.30	106			
OBE-04	12/21/2019	Step Drawdown Test	5.7	11.4	0.50	171	100	5.7	100
			3.8	7.7	0.49	147			
			1.9	5.6	0.34	116			
OBE-05	N/A	Step Drawdown Test	-	-	-	-	N/A	2.2	63
			-	-	-	-			
			-	-	-	-			
OBE-06	1/1/2020	Step Drawdown Test	5.4	7.6	0.71	211	100	6.0	100
			3.6	6.3	0.57	159			
			1.8	4.4	0.41	121			
OBE-07	1/1/2020	Step Drawdown Test	6.4	11.3	0.57	140	100	7.2	100
			4.2	8.2	0.51	124			
			2.2	4.9	0.45	111			
OBE-08	1/4/2020	Step Drawdown Test	4.5	11.1	0.41	108	100	4.0	100
			3.0	6.6	0.45	106			
			1.5	3.9	0.38	103			
OBE-09	N/A	Step Drawdown Test	-	-	-	-	N/A	11.2	70
			-	-	-	-			
			-	-	-	-			
OBE-10	1/4/2020	Step Drawdown Test	5.8	3.0	1.93	103	100	5.5	100
			3.8	2.0	1.90	102			
			1.9	1.0	1.90	101			
OBE-11	N/A	Step Drawdown Test	-	-	-	-	N/A	4.8	83
			-	-	-	-			
			-	-	-	-			
OBE-12	1/10/2020	Step Drawdown Test	6.7	6.4	1.05	278	100	7.3	100
			4.5	5.1	0.88	201			
			2.2	4.6	0.48	127			
OBE-13	N/A	Step Drawdown Test	-	-	-	-	N/A	14.6	100
			-	-	-	-			
			-	-	-	-			
OBE-14	N/A	Step Drawdown Test	-	-	-	-	N/A	1.5	50
			-	-	-	-			
			-	-	-	-			
OBE-15	N/A	Step Drawdown Test	-	-	-	-	N/A	0.8	50
			-	-	-	-			
			-	-	-	-			
OBE-16	N/A	Step Drawdown Test	-	-	-	-	N/A	3.2	68
			-	-	-	-			
			-	-	-	-			

Notes:
** - Hantush-Bierschenk method used to estimate well efficiency
If Estimated Well Efficiency for a step was greater than 100%, then the Estimated Average Well Efficiency was assumed to be 100% as a conservative estimate.
OBE-05/09/11/14/15/16 estimated well efficiencies based on PDI test in July 2016, pending subsequent testing